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# Medical Response/Search/Recovery and Lessons Learned From the Space Shuttle Columbia Accident Investigation

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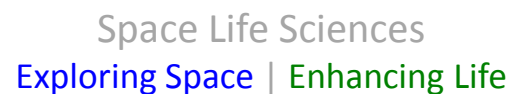


## Disclosure Information

### *82<sup>nd</sup> Annual Scientific Meeting*

*Philip C. Stepaniak*

- I have no financial relationships to disclose.
- I will not discuss off-label use and/or investigational use in my presentation





# NASA Response

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## MMT

Mission Management Team (MMT) members called to the Johnson Space Center (JSC) Mission Control Center (MCC) for initial response to the loss of the Columbia and its crew.

## MIT

Mishap Investigation Team (MIT) members named, contacted, and dispatched to Barksdale Air Force Base, Louisiana.

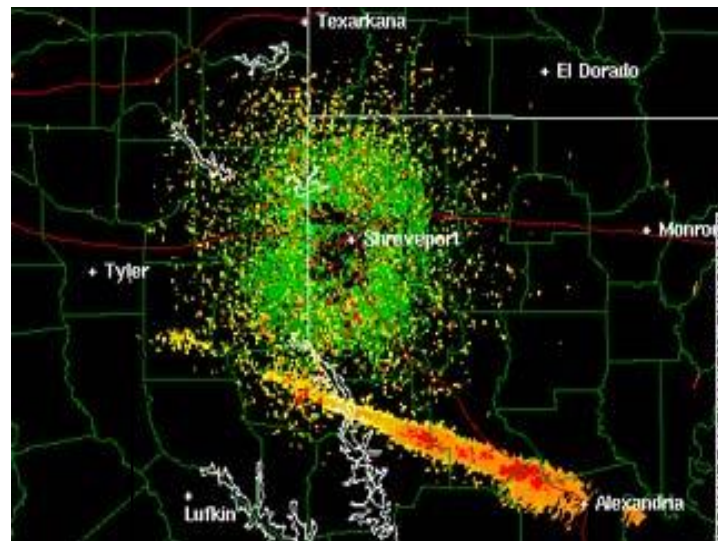
## DFO

Disaster Field Offices (DFO) were established at Lufkin TX, Fort Worth Naval Air Station TX, and Barksdale Air Force Base LA



# Federal Response

President Bush declared East Texas a federal disaster area, and enabled emergency response by the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA), National Transportation Safety Board (NTSB), Federal Bureau of Investigation (FBI), and other Federal, State and Local agencies of TX and LA



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# Mishap Investigation Team

## Personnel

- DOD

- DDMS
- BAFB Security
- BAFB Mortuary Affairs
- BAFB Flight Surgeons Office
- AFIP
- USAF Mortuary Affairs

- Disaster Field Offices (DFO)

- Federal

- FEMA
- NTSB
- EPA
- FBI

- NASA

- Security
- Legal
- Public Affairs
- Aircraft Operations



# Mishap Investigation Team

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## Summary of Events for HR Search and Recovery

- Barksdale Air Force Base Medical Operations
  - February 1-14, 2003
- Transitional operations at the Johnson Space Center Emergency Operations Center
  - February 14-16, 2003
- On-call operations
  - February 17, 2003



# Mishap Investigation Team

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Barksdale Air Force  
Base, LA





# Mishap Investigation Team



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# Mishap Investigation Team





# Mishap Investigation Team

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- Medical Mission Objectives
  - Receive, analyze, identify and transport human remains to Dover AFB and Armed Forces Institute of Pathology
  - Provide assistance in the recovery effort with the prime Disaster Field Office at Lufkin, TX
  - Brief Casualty Coordinators (CACO) and Crew Surgeons with latest recovery information for family notification



# Mishap Investigation Team

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- Medical Mission Objectives
  - Receive, analyze, store and transport crew escape/life support equipment to the Kennedy Space Center and AFIP
  - Receive, store and transport biological payloads to Kennedy Space Center and the Johnson Space Center
  - Provide information and guidelines to local physicians, civilians and search teams for medical concerns and occupational health care issues associated with spacecraft toxic hazardous substances



# HR Search Methods

- Line Searches
- Canine Teams
- Equine Teams
- Avian Indications
- Canopy Condition
- Airborne Spotters



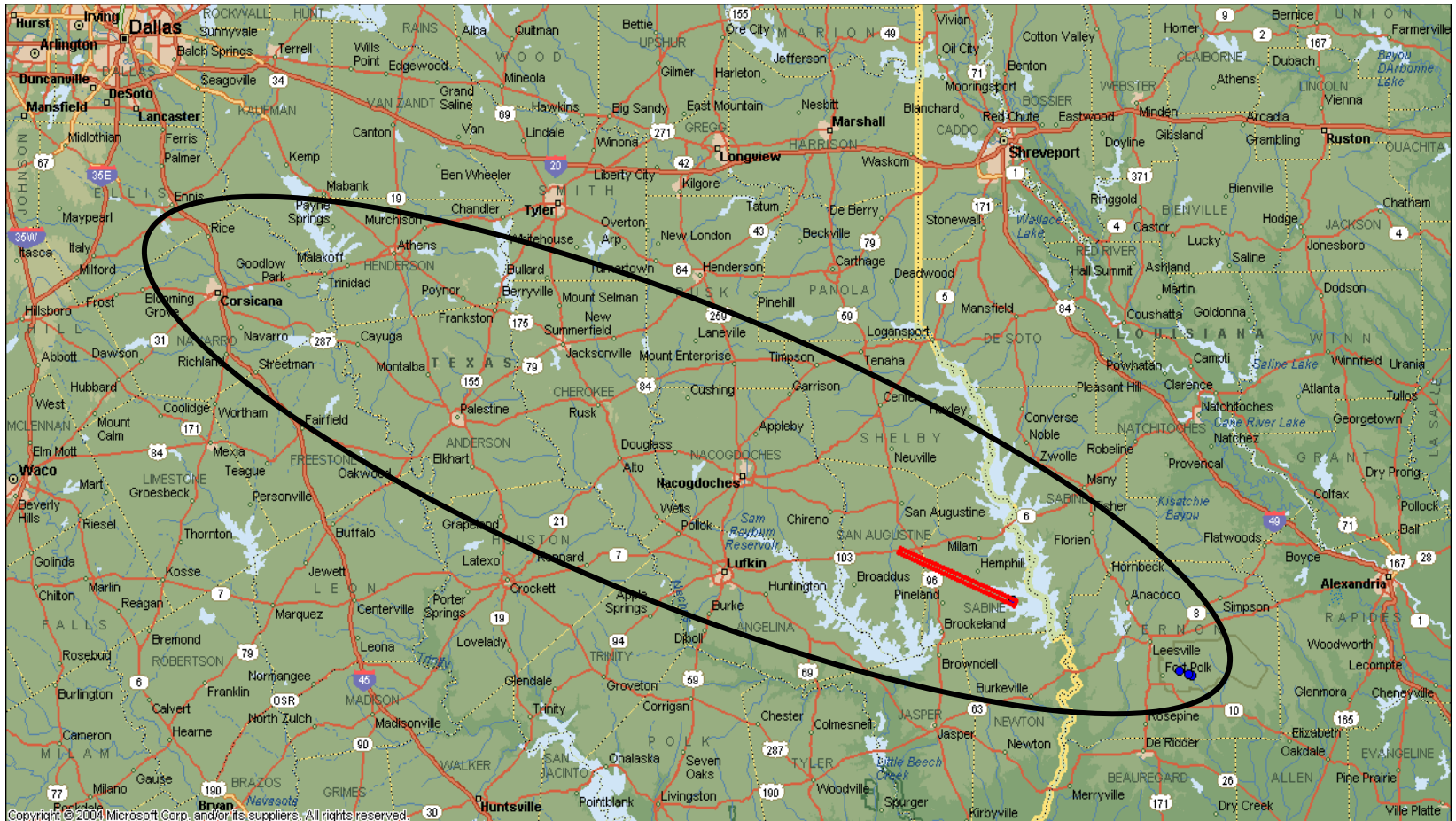


# Columbia Recovery





# First Day (200 mi. x 50 mi.)

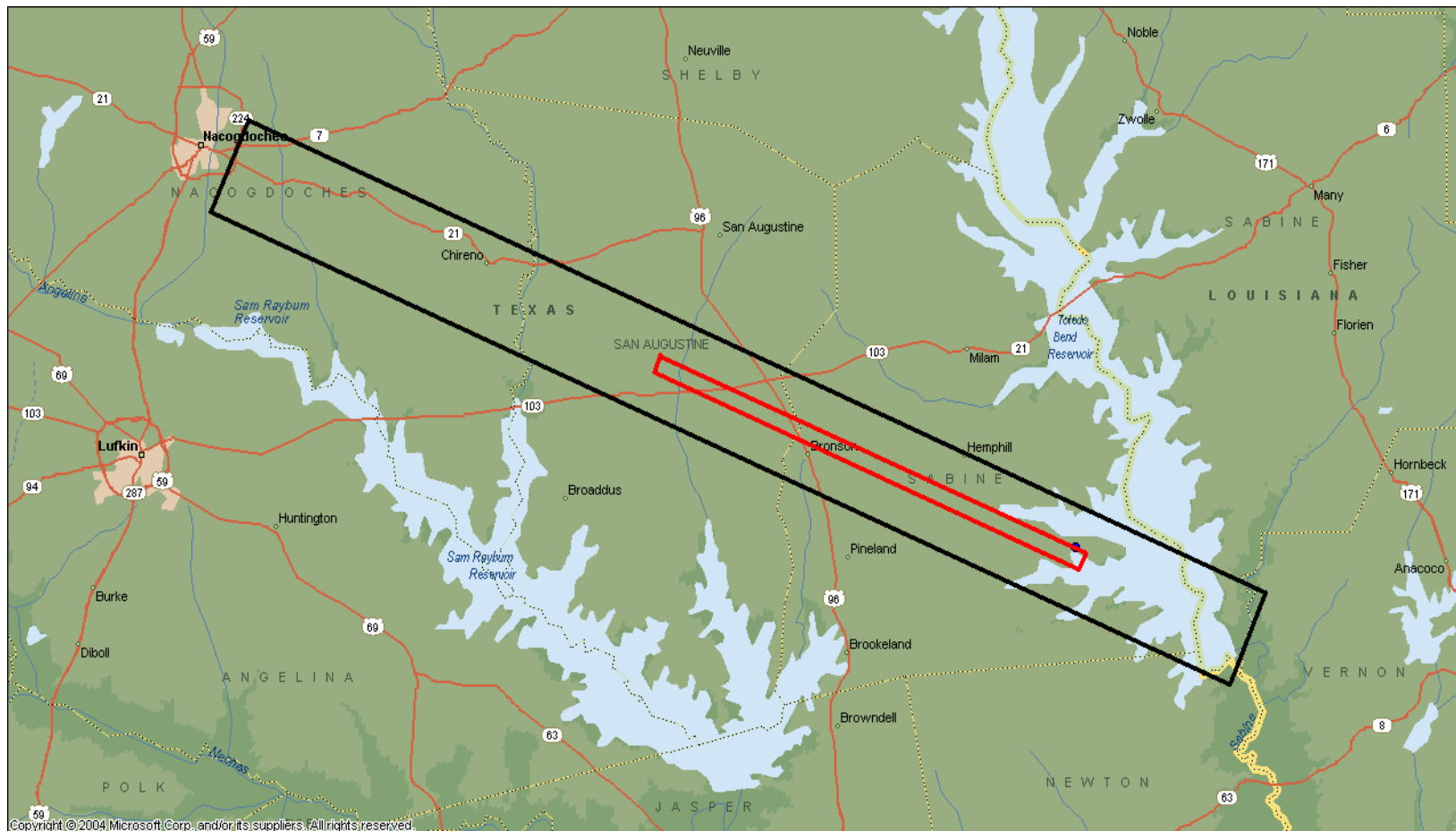


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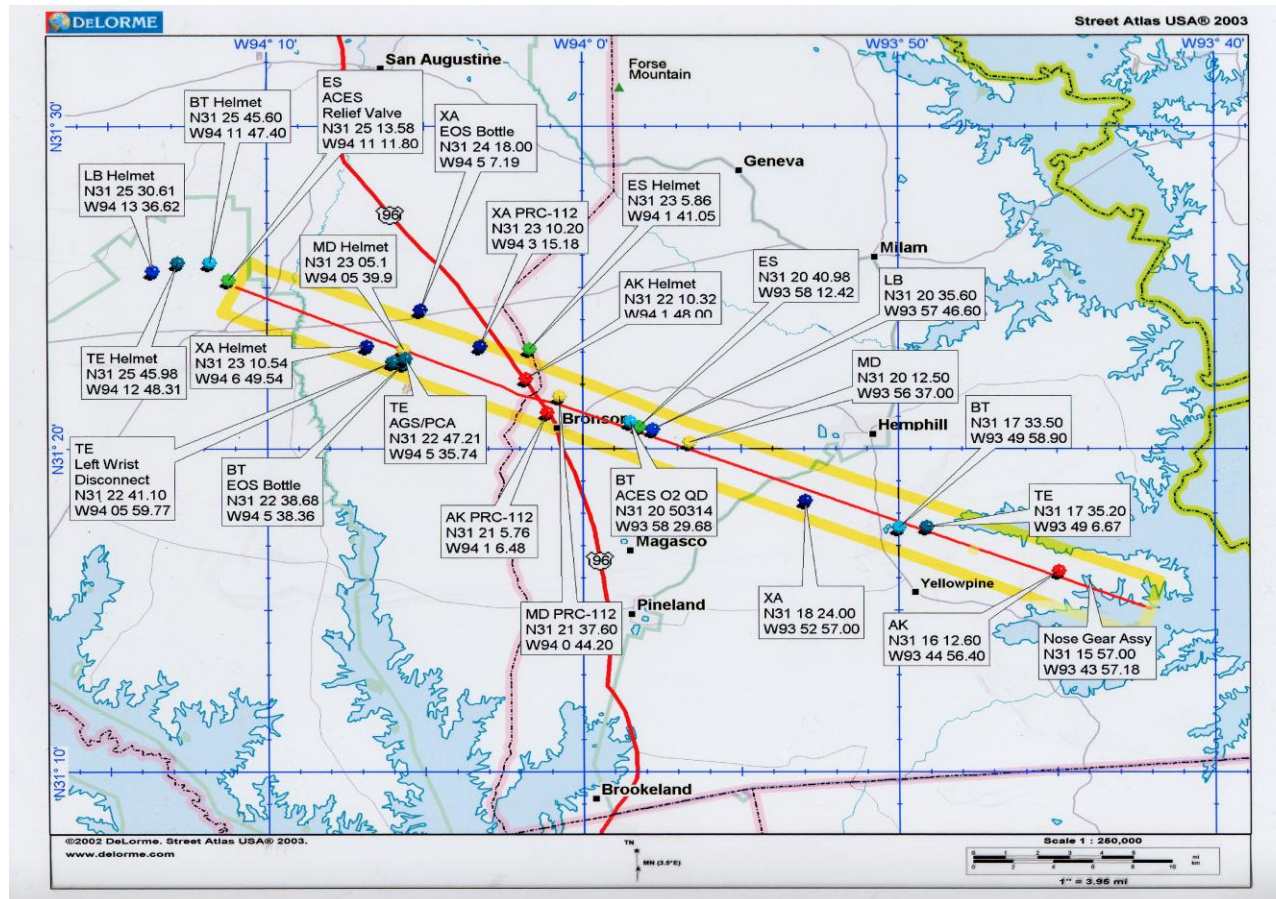


# Second Day (60 nm. x 5 nm.)





# Crew Escape Equipment and Human Remains



Corridor 30 x 2 statute miles

Crew escape equipment found in western 16 miles of corridor  
HR recovered in eastern 14 miles of corridor



# Recovery – General Observations

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- Initially unable to visually ID crewmembers
  - Dental Forensics
- No life support equipment was found on crew
- Dermatopathology
- Patterns of Injury
  - Same but different



# Death Certificates

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- Acute multiple trauma secondary to aerodynamic and thermal effects at altitude over the skies of Texas



# Barksdale AFB



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# Barksdale AFB



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# Barksdale AFB



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# Port Mortuary – Dover AFB

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# Mishap Investigation Team

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- Aeromedical Lessons Learned
  - Personnel
  - Equipment
  - Procedures
  - Communications



# Mishap Investigation Team

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## Aeromedical Lessons Learned Personnel

- Crew Surgeon and Deputy Crew Surgeon assigned to the mission provide support to crewmember's families
- Medical Operations Contingency Group assigned to the Mishap Investigation Team
- Deploy medical operations personnel to primary Disaster Field Offices



# Mishap Investigation Team

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## Aeromedical Lessons Learned Personnel

- Conduct a medical team tag-up ASAP when all primary points of contact have arrived at the Mishap Investigation Team location
  - Establish responsibilities
  - Coordinate operations
- Psychological debrief after TDY



# Mishap Investigation Team

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## Aeromedical Lessons Learned Personnel

- Personnel assigned to human remains recovery should be trained and experienced (FBI)
- Field teams briefed on guidelines for personal health protection



# Mishap Investigation Team

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## Aeromedical Lessons Learned

### Equipment

- Deploy with sufficient equipment and supplies to be self-sufficient for three days
  - Computer supplies
  - Office supplies
- FEMA
  - Coordinate needs early



# Mishap Investigation Team

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## Aeromedical Lessons Learned Procedures

- Collection points and temporary morgue for analysis and initial identification
- Chain of custody for all human remains, crew life support equipment and personal property
- Comingled human remains discovered within spacecraft debris



# Mishap Investigation Team

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## Aeromedical Lessons Learned Procedures

- Biological payloads
- Public concerns related to toxic hazardous substances associated with spacecraft mishaps



# Mishap Investigation Team

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## Aeromedical Lessons Learned Procedures

- Coordinate the religious and cultural differences for international crewmembers
- Mapping of recovered human remains to assist recovery operations



# Mishap Investigation Team

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## Aeromedical Lessons Learned Procedures

- Establish exit strategy and transitional plans for late-phase human remains recovery
  - Plans should be pre-coordinated with all members of the Mishap Investigation Team and supporting agencies
- Timely and accurate completion of death certificates
  - Updated the flight medicine clinic database for all crews



# Mishap Investigation Team

FINAL/Version 1

10:00, 4 Feb 2003

## Guidelines for the Collection of Space Shuttle Material by Public Service Personnel

The following guidelines are designed to assist public service personnel to determine when and how to collect and document space shuttle material. If the materials is less than 18 inches in length and does not appear to be hazardous, then it may be collected under the following guidelines:

### **Authorized Public Service Personnel:**

Local, State, or Federal Law Enforcement Personnel  
Fire, Medical, or Emergency Services Personnel  
US Forest Service or Texas Forest Service  
Federal Emergency Management Agency (FEMA)  
Environmental Protection Agency (EPA)/TCEQ & CST  
National Aeronautics and Space Administration (NASA)  
Individuals from any of these agencies will be able to provide verifiable identification.

### **Encountering Hazardous Material:**

Hazardous materials may be associated with the space shuttle. If you suspect that hazardous material is present, secure the area and call 936-699-1032/1034 to report what you have found. Specially trained personnel will be dispatched to recover the item.

### **Potential Hazards (DO NOT TOUCH):**

**Stored Energy:** High Pressure Tanks and Cylinders, Landing gear and tires.  
**Monomethyl Hydrazine:** Clear liquid stored in tanks, strong fishy odor.  
**Nitrogen Tetroxide:** Greenish liquid or brownish vapor, stored in tanks, bleach like odor.  
**Ammonia:** Clear liquid, stored in tanks, very strong ammonia smell.  
**Pyrotechnic Devices:** Landing gear, window frames, crew seats, hatches and antennae.  
**Biological Material:** Any biological material, including human or animal remains.

### **Procedure for Collecting Shuttle Material:**

Photograph items before they are moved. Carefully document the location of the items (to include GPS data if available). Attach a tag to the item with the location the item was found and the name and phone number of the individual collecting the item. Include any information you think may be relevant to the investigation. Documentation for large items may be recorded with permanent marker directly on the hardware. Wear gloves (preferably not cloth) when handling items and do not open, adjust or move any switches, components or boxes. If possible, seal the item in a plastic bag. Transport the item to your local command post.

If an item is marked SECRET, CONFIDENTIAL, or SSOR do not leave the item unattended before handover to NASA personnel.

Astronaut crew remains information should be relayed directly to 936-699-1032/1034.

With any questions or for more information, please contact DPS at the Lufkin Emergency Operation Center, 936-699-1077.

## Guidelines for the Collection of Space Shuttle Material by Public Service Personnel



# Mishap Investigation Team

## OVERALL PLAN FOR THE HANDLING OF: DEBRIS, CREW EQUIPMENT/PERSONAL EQUIPMENT, HUMAN REMAINS AND BIOHAZARDS

This plan was developed by Capt. Wetherbee, and Dr. Stepaniak with input by AF Medical Examiners Office and others.

1. Debris will be shipped to Barksdale AFB and then packaged for shipment to Kennedy Space Center (KSC).
2. Crew equipment/life support equipment will be accumulated at Lufkin or Barksdale AFB. Equipment accumulated at Barksdale will be sent on to KSC. The JSC life support personnel will be available, at Barksdale, to assist in reviewing debris that is thought to be life support equipment and assist in getting it isolated. The equipment will be held in a designated area of the nose dock 6 (debris collection hangar). The equipment will be packaged and shipped to KSC and labeled as crew equipment/life support equipment. At KSC, the debris will again be screened for crew equipment/life support items by a crew representative.
3. Human remains will transition to a late phase operation. Formal human remains efforts terminated on Feb 13th in the Lufkin and Barksdale area. Individuals who have recovered suspected Human Remains are to be referred to their local law enforcement authorities. This includes Sheriff departments, Justice of Peace and State police. FEMA will notify these agencies when this operation is activated.  
  
Law enforcement authorities are to contact USAF Mortuary Affairs at 800-531-5803. USAF will coordinate with the local authorities and arrange to have the remains transported to Dover or other appropriate facility for examination by the local Office of the Armed Forces Medical Examiner.
4. Biohazards/Biochemical from the payloads etc. are to be accumulated at Lufkin and/or Barksdale. From these two locations the biohazards will be sent to Johnson Space Center (JSC). The POC for the transportation of biohazards at Barksdale is Mr. Stephen Brock. He can be contacted at 318-456-7255 or on cell phone 281-770-7388. The POC at JSC is Dr. Nitza Cintron or Mr. Steve Gaylor. Dr. Cintron can be contacted at 281-483-6291 or pager 888-438-4130.

Questions concerning Human Remains, life support, or biohazards should be directed to the Mishap Investigation Team (MIT) Medical Operations team. The Medical Operations team has relocated to the JSC Emergency Operations Center (EOC). The EOC will be staffed during duty hours. The phone numbers are 281-244- 5454 (primary), or 281-483-9839. The Fax is 281-483-5680. FCOD/CB also has a contact number at the EOC, which is 281-483-9842 and the same fax number.

## Overall Plan for Handling of Debris, Crew and Personal Equipment, Human Remains, Biohazards



# Mishap Investigation Team

## NASA HUMAN REMAINS Columbia Mishap Recovery Guidelines

### CONCEPTS OF OPERATIONS

- Optimize utilization of resources available within the main search area
- Deliver suspected Human Remains (HR) as expeditiously as practical for definitive forensic analysis by the Armed Forces Medical Examiner

### CURRENT OPERATIONS

#### Material Within the Main Search Area

Teams in the main search area near Lufkin, TX will log and collect HR. If a prudent layperson would reasonably conclude biological material is of nonhuman origin (e.g. deer skulls), it need not be collected. All other HR, clothing, and Crew Escape Equipment that appears to contain biologic material (e.g. blood) should be forwarded to the Temporary Morgue Facility (TMF) at Barksdale for DNA testing and other forensic analysis.

HR should be transported no less often than daily from the Lufkin collection point to the Barksdale TMF. NASA Medical at Barksdale AFB should be notified immediately of the recovery of larger HR; a determination can then be made regarding the urgency of transport and for protocol arrangements.

Suspected HR will be collected at Barksdale AFB, LA and transported to Dover AFB, DE for forensic examination. A routine end-of-day run from Lufkin to the Barksdale TMF is recommended, but HR can be accepted at Barksdale 24 hours a day. Prior to any HR transport from Lufkin, the Barksdale Command Post should be notified at (318) 456-2151.

A Shuttle Training Aircraft is on standby at Ellington for daily flights to Dover and typically departs Barksdale in the late morning. Since these are dedicated support flights, they can be planned for any time of day as required.

#### Material Outside the Main Search Area

Calls for HR found outside the main search area do not necessarily require recovery by NASA field teams. Local law enforcement authorities may forward suspected HR directly to the Barksdale TMF. This may be done either by local law enforcement courier or commercial overnight transport

For material sent via commercial overnight express, the following address should be used:

2 SVS/SVMX  
ATTN: Maj. Ogden  
50 Vandenburg Drive, Suite 239  
Barksdale AFB, LA 71110

Prior to forwarding, the Medical Team at Barksdale should be contacted at: 318-456-7275.

### LATE-PHASE OPERATIONS

When formal HR recovery efforts are terminated, the Lufkin and Barksdale facilities will cease operations. USAF Mortuary Affairs will assume coordination of HR recovery. Individuals who have recovered suspected HR from the Columbia crew should contact their local law enforcement authorities. These entities should in turn, contact Air Force Mortuary Affairs at 800-531-5803. USAF Mortuary Affairs will coordinate with the local authorities and arrange to have the suspected remains transported to Dover or other appropriate facility for examination by the Office of the Armed Forces Medical Examiner.

## Late Phase Human Remains Recovery



# Mishap Investigation Team

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## Aeromedical Lessons Learned Communications

- Single point of contact with NASA medical management for reporting findings
- Single point of contact at each Disaster Field Office
- Notify Casualty Coordinators and Crew Surgeon daily with updated information for family member's briefing



# Mishap Investigation Team

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## Aeromedical Lessons Learned Communications

- Make no assumptions – communicate only verifiable information on secure lines
- Do not promise anything you cannot personally deliver
- Be flexible within the mix of reality, perception and politics of the accident investigation process



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